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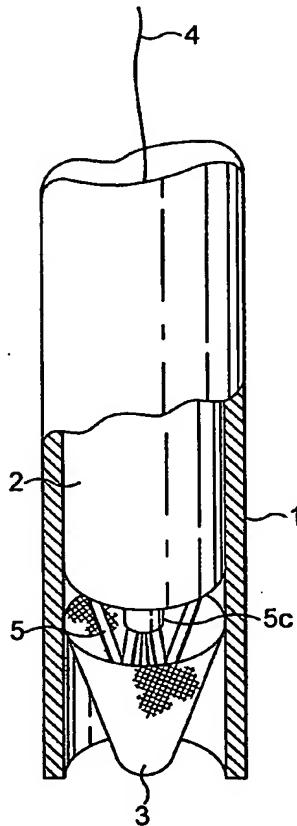
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[Continued on next page]

(54) Title: LAPAROSCOPIC PORT HERNIA DEVICE

(57) Abstract: An applicator assembly for use in applying a sheet of surgical material through an opening to bridge the remote internal termination of the opening has a deployment sleeve (1), a plunger (2) for location within the sleeve (1) and a sheet of surgical material (3) which can be folded or collapsed to a conical form as shown for location at and within the distal end of the deployment sleeve. An actuating means (4) comprising a suture is provided operative to unfold or erect the sheet (3) following expulsion from the distal end of the deployment sleeve (1) through longitudinal movement of the plunger (2). The sheet (3) includes radial ribs (5) connected along their length to the sheet except at an inner region (5a) defined by a hinge (5b) where the ribs are free and joined at the ends to a collar (5c) through a further hinge connection.



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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**Title:****Laparoscopic Port Hernia Device.**

This invention relates to a laparoscopic surgical material and an applicator primarily intended for internal closure of an incision to prevent formation of a port-site hernia following a surgical procedure, or operation. 5 Secondarily, prevention of formation of internal organ adhesion at the operation site may be helped.

Laparoscopic surgery is used increasingly and requires the provision of one or more "tunnels" through all layers of the body wall, forming ports through 10 which a surgical procedure is effected remotely using various instruments, a telescope or camera and a light source. For a laparoscopic cholecystectomy, for example, three such ports are used typically, with 0.5 to 1 cm incisions down through the layers of abdominal wall, with one port very often through the umbilicus. Typically each port is closed, following the procedure, with outer skin 15 stitches only, thus leaving the deeper layers to heal themselves. This small incision has the potential, later, to become an incisional or port hernia. Internally, the unrepaired port opening can allow, potentially, a bowel portion to herniate through or may offer an adhesion point for bowel, with the potential then for bowel obstruction.

20 It is a primary objective of this invention to provide a surgical material and applicator for use in the closure of port incisions, such as those following laparoscopic procedures and which is simple to use through the same laparoscopic port lumen and which has a minimum of components.

Another object is to provide a collapsed device structure which may be

readily passed down the port and then opened out internally, located into and across the opening.

According to one aspect of this invention there is provided an applicator assembly for use in applying a sheet of surgical material through an opening to

5 bridge the remote internal termination of the opening, the assembly comprising;

- a) a deployment sleeve;
- b) a plunger for location within the sleeve, to extend from the proximal to the distal end thereof;
- c) a sheet of surgical material which can be folded, or collapsed, for location at and within the distal end of the deployment sleeve;
- 10 d) an actuating means operative to unfold or erect the sheet following expulsion from the distal end of the deployment sleeve through longitudinal movement of the plunger and, optionally,
- e) a further means such as a suture, operative to apply a pull force to the sheet following deployment.

15

In this arrangement, and according to the invention, the sheet material is encased and protected within the deployment sleeve during the manipulation procedure to position the sleeve at the termination of the opening after which the sheet is expelled by the plunger to be erected to close behind and over the

20 internal area of the opening.

The sheet of surgical material will generally be of a known surgically compatible mesh such as polypropylene, most likely including a PTFE or similar non-stick material on one surface, that is the innermost facing surface. The

entire part however, may be wholly of PTFE, for example, "textured on the surface away from the bowel. The material is normally a flat flexible sheet, for example circular, and may include radial ribs forming more rigid but resilient arms through which, when the sheet is forced to a collapsed or folded

5 configuration, the sheet is caused to open out to restore the flat form. This action may be likened to the opening of an umbrella and a feature is that the opening can be effected through the properties of the sheet itself not requiring additional mechanical components. As an alternative, or in addition, opening is effected through a suture which pulls the sheet upward towards the applicator.

10 The central part of this arrangement of arms, may locate within the internal defect to aid closure.

In an embodiment, the ribs have preformed fold creases to facilitate collapse to a predetermined configuration. Alternatively, the ribs may have a "memory" acting to restore the sheet to a flat form. Following deployment of the

15 sheet the opening thereof may be effected or assisted by a separate actuating means which may comprise a suture thread, with or without an attached suture needle, extending through the plunger from the proximal to the distal end of the sleeve and connecting with the sheet. The suture is arranged so that a pulling force applied thereto opens the sheet. The suture may then be removed, or

20 severed, or broken. In this embodiment, the suture may be used for applying traction to position the sheet and to close the wound using the attached needle.

According to another aspect of this invention, there is provided a sheet of surgical material including ribs or radially extending formations which may be resiliently flexed and which, on restoration, extend the sheet from a folded,

25 pleated or crumpled form to a flat and self-supporting form.

According to yet another aspect of this invention there is provided a sheet of surgical material including radial ribs each rib being hinged to allow outer parts of the sheet to be folded inwards into a conical shape, the sheet being extended to a flat form by an actuating means. The sheet in these 5 embodiments thus opens in the manner of an umbrella. The arms may be constructed of a biodegradable material, this being preferred but not essential.

To explain the features of this invention further reference is now made to the drawings showing an embodiment by way of an example. In the drawings:

Fig. 1 shows a surgical mesh and an applicator in accordance  
10 with this invention in partial sectional view and in a first assembly stage,

Fig. 2 shows the applicator in a loaded stage,

Fig. 3 shows the applicator during initial deployment,

Fig. 4 shows the applicator with the sheet partially opened,

15 Fig. 5 shows the applicator with the sheet fully opened,

Fig. 6 shows the sheet after withdrawal of the applicator, and

Fig. 7 shows in diagrammatic form a closure.

Referring to Fig. 1 of the drawings, an applicator assembly for use in applying a sheet of surgical material through an opening to bridge the remote 20 internal termination of the opening has a deployment sleeve 1, a plunger 2 for location within the sleeve 1 and which has a length sufficient to extend from the proximal to the distal end of the sleeve and a sheet of surgical material 3 which can be folded or collapsed to a conical form as shown for location at and within

the distal end of the deployment sleeve. The material can equally well be located the other way round, that is with the apex adjacent the plunger 2. An actuating means 4 comprising a suture is provided operative to unfold or erect the sheet 3 following expulsion from the distal end of the deployment sleeve 1

5 through longitudinal movement of the plunger 2. The sheet 3 is conveniently circular, typically, of some 3 cm or so in diameter. The inner facing surface will include a PTFE coating or layer to inhibit adhesion of tissue, notably bowel. The outward facing surface will be of uncoated polypropylene mesh, "textured" PTFE or similar, to facilitate incorporation into the body wall tissues. Those

10 familiar with the art will be conversant with the term "textured" PTFE as used herein.

The sheet 3 includes radial ribs 5 connected along their length to the sheet except at an inner region 5a defined by a hinge 5b where the ribs are free and joined at the ends to a collar 5c through a further hinge connection (see

15 Figs. 4 to 6). The hinge connection may be formed by crease lines or zones of reduced thickness or width. The ribs preferably comprise a biologically absorbable polymer material, for example Vycryl® or PDS, or they may be of a non-biodegradable material.

The suture 4 forming the actuating means connects to the centre of the

20 sheet and passes through the collar 5c and the plunger 2 to the proximal end.

Laparoscopic ports are generally 0.5 to 1.0 cm in nominal diameter and thus sleeve 1 is appropriately dimensioned to pass down the port device. The suture may be absorbable Vycryl® or similar and pass all the way through the plunger to a needle. At the termination of the laparoscopic procedure following

withdrawal of instruments the applicator assembly will be fed through the port device. The outer sleeve may, or may not, have an externally placed flange to control the length of insertion in the port and the plunger may likewise have a flange to control the position in the sleeve.

5        The operation is as follows:-

The sleeve 1 includes the folded or collapsed mesh 3 previously located in the distal end with suture 4 fitted, and then receives the plunger 2 (Fig. 1)

The plunger 2 is then pushed down onto the collar 5c (Fig. 2)

Deployment is effected after location through a laparoscopic port device  
10 by pushing down the plunger to expel the mesh out of the end of the sleeve 1  
(Fig. 3)

Suture 4 is then pulled tight causing the mesh 3 to open through the unfolding of the rib parts 5 and 5a (Fig. 4) and to present a load dissipating support mesh closing the incision.

15       With the mesh now fully unfolded (Fig. 5) the sleeve and plunger may be withdrawn, usually accompanied by removal of the originally placed port device, leaving the mesh 3 in position (Fig. 6).

Fig. 7 shows in a diagrammatic way the installed mesh wherein G represents the gut, as example, and A represents the abdominal wall.

20       In one arrangement the suture is connected to a straight needle, such that the needle can pass down the lumen of the plunger, allowing the placement system to be discarded. Alternatively, the outer sleeve and plunger could be perforated along their entire lengths, such that both could be pulled

apart, down the perforation and discarded. In either case, the placement system would be removed from the port device and the port device removed secondarily. If no needle was present then all devices could be removed simultaneously, with the thread used for traction only, being tied off in to the 5 wound by a second wound closure suture used independently. The suture could be used for directly to close the wound, if desired.

If the placement system outer sleeve had preferentially no flange, then the port device could be slid off over it, prior to mesh deployment.

In a modification of this invention and for use in similar scenarios to 10 laparoscopic ports, e.g. at an appendicectomy, a larger sheet of mesh for example, with the inner aspect covered with PTFE (Teflon) could be placed to prevent post-operative adhesion of bowel. This mesh could have one, two or more sutures attached along its length. This arrangement would utilise the sheet which unfolds but the use of the applicator would not be essential in this 15 case.

When placed at the end of (open) surgery, the mesh overall would help dissipate load at the wound site, helping prevent incisional hernia formation. The PTFE inner aspect would help prevent bowel or organ adhesion. The polypropylene mesh, or "textured" PTFE, outer aspect would help incorporation 20 into the peritoneum. The attached sutures could be pulled, to tension the mesh against the inside of the abdominal wall. Attached needles could then be used to close the wound. Having different numbers of needles along a length of mesh means that the mesh could be cut to any length required. Longer mesh would necessarily be broader also.

**CLAIMS**

1. An applicator assembly for use in applying a sheet of surgical material through an opening to bridge the remote internal termination of the opening, the assembly comprising;
  - 5 a) a deployment sleeve;
  - b) a plunger for location within the sleeve, to extend from the proximal to the distal end thereof;
  - c) a sheet of surgical material which can be folded, or collapsed, for location at and within the distal end of the deployment sleeve;
  - 10 d) an actuating means operative to unfold or erect the sheet following expulsion from the distal end of the deployment sleeve through longitudinal movement of the plunger.
2. An applicator assembly in accordance with claim 1, including a pulling means operative to apply a pull force to the sheet following deployment.
- 15 3. An applicator assembly in accordance with claim 2, wherein the pulling means is a suture.
4. An applicator assembly in accordance with any preceding claim, wherein the sheet material, in use, is encased and protected within the deployment sleeve during the manipulation procedure to position the sleeve at the 20 termination of the opening after which the sheet is expelled by the plunger to be erected to close behind and over the internal area of the opening.
5. An applicator assembly in accordance with any preceding claim, wherein the sheet of surgical material comprises a known surgically compatible

mesh such as polypropylene, preferably including a PTFE or similar non-stick material on one surface, being the innermost facing surface adjacent to the applicator.

6. An applicator assembly in accordance with claim 5, wherein the entire sheet is wholly of PTFE.
7. An applicator assembly in accordance with any preceding claim, wherein the sheet material is normally a flat flexible sheet, preferably circular, and includes radial ribs forming more rigid but resilient arms through which, when the sheet is forced to a collapsed or folded configuration, the sheet is caused to open out to restore the flat form.
8. An applicator assembly in accordance with claim 7, wherein the opening is effected through the properties of the sheet material itself.
9. An applicator assembly in accordance with any preceding claim, wherein opening is effected or assisted through a suture which pulls the sheet upward towards the applicator.
10. An applicator assembly in accordance with any preceding claim, wherein the sheet includes ribs which have preformed fold creases to facilitate collapse to a predetermined configuration.
11. An applicator assembly in accordance with any preceding claim, wherein the sheet includes ribs which have a "memory" acting to restore the sheet to a flat form.
12. An applicator assembly in accordance with any preceding claim, wherein, in use, after deployment of the sheet the opening thereof is effected or assisted by a separate actuating means which may comprise a suture

needle, with or without an attached suture, extending through the plunger from the proximal to the distal end of the sleeve and connecting with the sheet, the suture being arranged so that a pulling force applied thereto opens the sheet.

- 5    13. A sheet of surgical material including ribs or radially extending formations which may be resiliently flexed and which, on restoration, extend the sheet from a folded, pleated or crumpled form to a flat and self-supporting form.
- 10    14. A sheet of surgical material including radial ribs each rib being hinged to allow outer parts of the sheet to be folded inwards into a conical shape, the sheet being extended to a flat form by an actuating means.
- 15    15. A sheet of surgical material in accordance with claim 13 or 14, wherein the ribs are of a biodegradable material.
- 16    16. An applicator assembly for use in applying a sheet of surgical material through an opening to bridge the remote internal termination of the opening substantially as described herein and exemplified with reference to the drawings.
- 20    17. A sheet of surgical material including radial ribs each rib being hinged to allow outer parts of the sheet to be folded inwards into a conical shape, the sheet being extended to a flat form by an actuating means as described herein and exemplified with reference to the drawings.

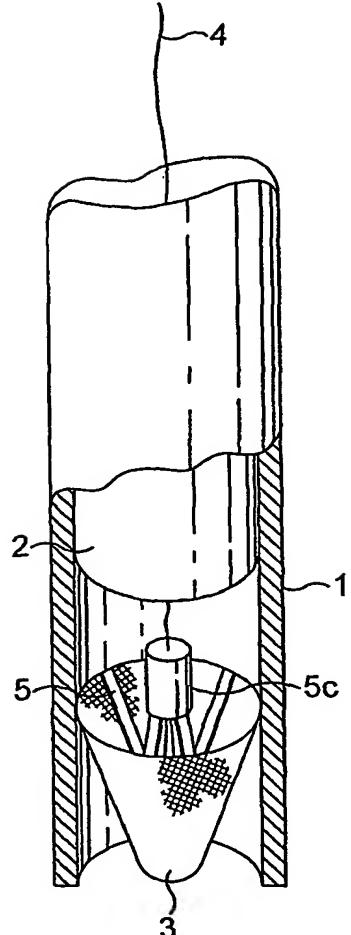


FIG. 1

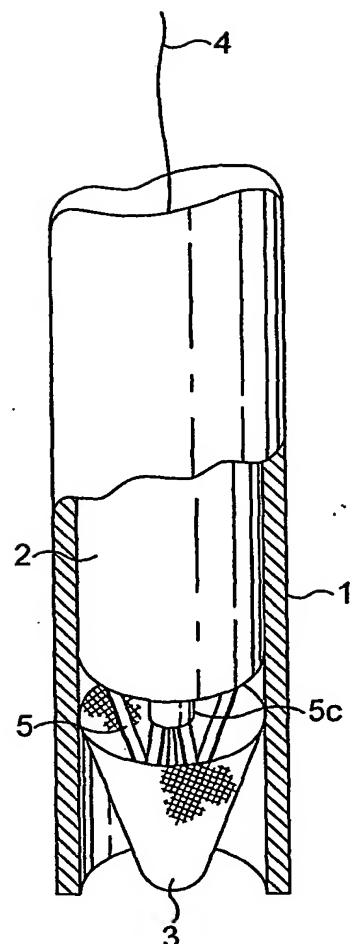


FIG. 2

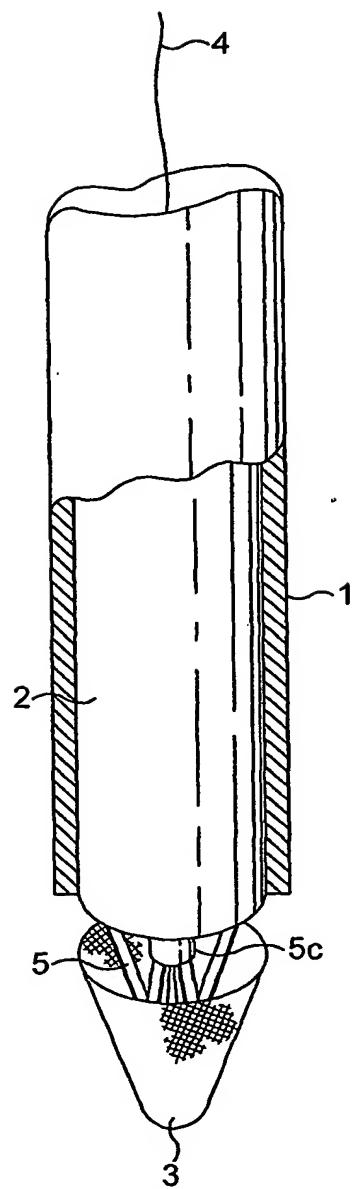
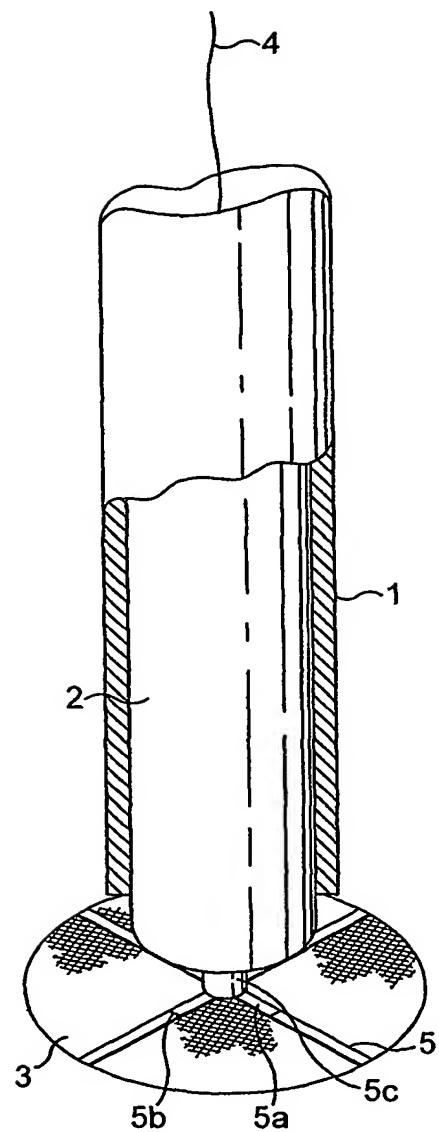
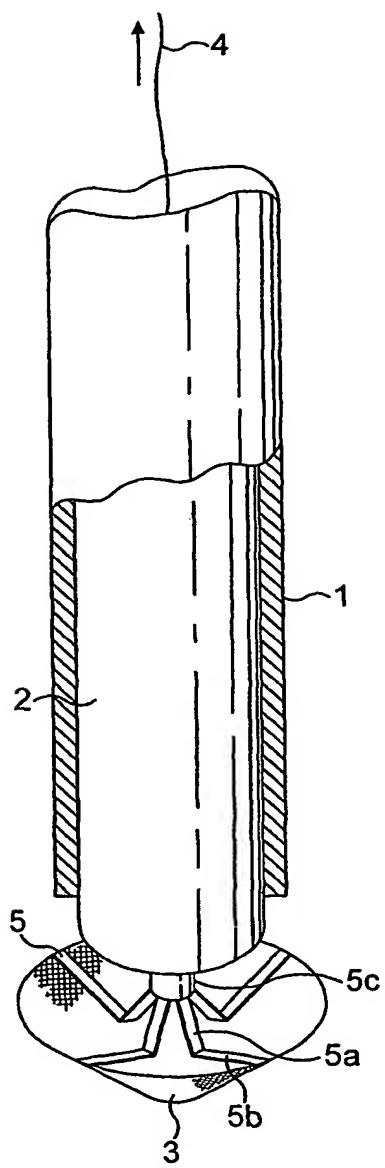
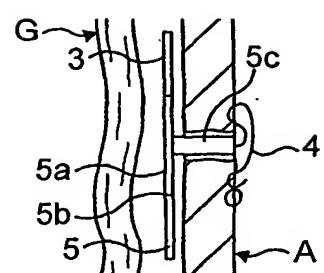
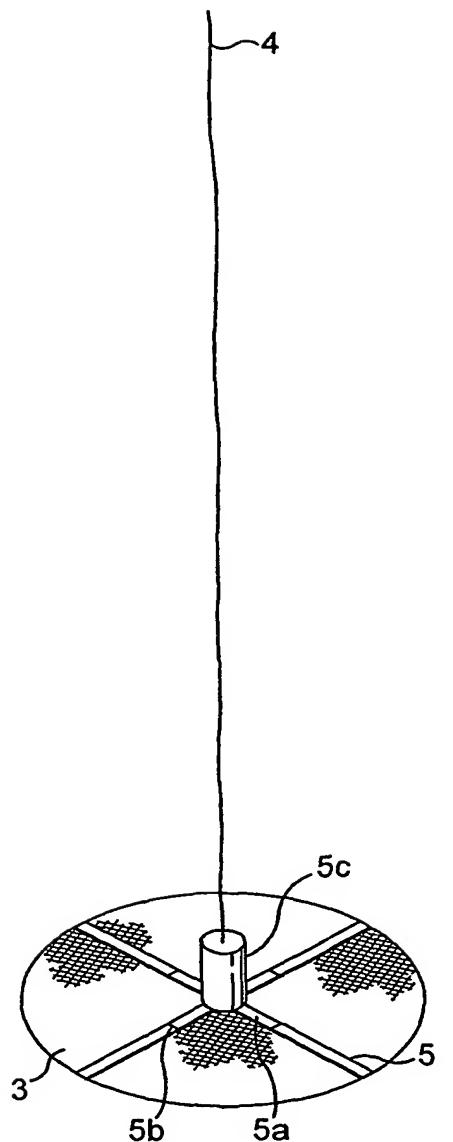


FIG. 3

2 / 3



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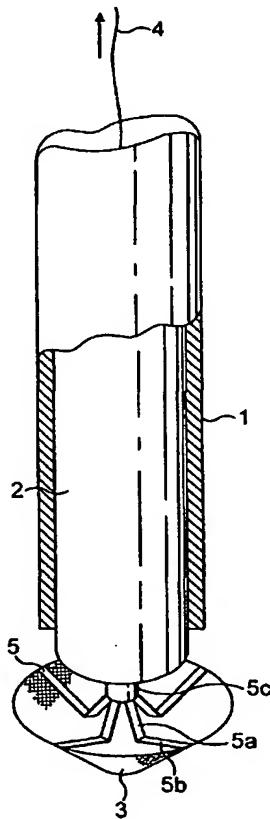
(71) Applicant and  
(72) Inventor: BARKER, Stephen, G. E. [GB/GB]; 16 Wilks Gardens, Shirley, Surrey CR0 8UJ (GB).

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*[Continued on next page]*

(54) Title: LAPAROSCOPIC PORT HERNIA DEVICE

(57) **Abstract:** An applicator assembly for use in applying a sheet of surgical material through an opening to bridge the remote internal termination of the opening has a deployment sleeve (1), a plunger (2) for location within the sleeve (1) and a sheet of surgical material (3) which can be folded or collapsed to a conical form as shown for location at and within the distal end of the deployment sleeve. An actuating means (4) comprising a suture is provided operative to unfold or erect the sheet (3) following expulsion from the distal end of the deployment sleeve (1) through longitudinal movement of the plunger (2). The sheet (3) includes radial ribs (5) connected along their length to the sheet except at an inner region (5a) defined by a hinge (5b) where the ribs are free and joined at the ends to a collar (5c) through a further hinge connection.



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# INTERNATIONAL SEARCH REPORT

Int'l Application No  
PCT/GB2004/000129

**A. CLASSIFICATION OF SUBJECT MATTER**  
 IPC 7 A61F2/00 A61B17/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
 IPC 7 A61F A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 397 331 A (HIMPENS JACQUES ET AL) 14 March 1995 (1995-03-14) column 4, line 66 - column 6, line 16 -----	1-9, 11-13,15
X	DE 200 09 815 U (AESCULAP AG & CO KG) 17 August 2000 (2000-08-17) page 3, paragraph 2 - paragraph 4 -----	1-6,9, 12,13,15
X	US 6 117 159 A (BUSCEMI PAUL J ET AL) 12 September 2000 (2000-09-12) column 4, line 34 - line 44 column 7, line 55 - line 58 -----	10,14,15
X	US 5 425 744 A (RAMAN L VEN ET AL) 20 June 1995 (1995-06-20) column 4, line 48 - line 56; figure 1 -----	13-15

Further documents are listed in the continuation of box C.

Patent family members are listed in annex.

\* Special categories of cited documents :

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
- \*L\* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

- \*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- \*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- \*Y\* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- \*G\* document member of the same patent family

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Name and mailing address of the ISA

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Authorized officer

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## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB2004/000129

### Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1.  Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:
  
2.  Claims Nos.: 16, 17 because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:  
see FURTHER INFORMATION sheet PCT/ISA/210
  
3.  Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

### Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1.  As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2.  As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3.  As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4.  No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

#### Remark on Protest

The additional search fees were accompanied by the applicant's protest.  
 No protest accompanied the payment of additional search fees.

## INTERNATIONAL SEARCH REPORT

International Application No. PCT/GB2004/000129

### FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 16,17

Claims 16 and 17 have not been searched as it defines its subject-matter by referring to the drawings, which is not allowed pursuant to the Guidelines PCT/GL/ISPE/1 Chapter 5, paragraph 5.10 and Article 6 PCT.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

# INTERNATIONAL SEARCH REPORT

Information on patent family members

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